An Experimental Infrasound Detector

by Jim Hale

Recent news reports concerning the possible psycho-physiological effects of infrasound have captured the attention of the paranormal research community and I've received many requests for information about the home-made infrasound detector mentioned on our group's website.

My original 'coffee can' infrasound detector was based on an electronic component called a geophone that was manufactured for use in earthquake monitoring equipment. That particular component was purchased many years ago from an electronics surplus vendor and is no longer available - but fortunately, the basic principles for building a similar device can be employed by substituting an ordinary audio speaker for the geophone.

The Original "Infrasonder"

The experimental infrasound detector I'm about to describe is an attempt to help make such a device readily available at reasonable cost to paranormal investigators. This isn't going to be an overly detailed how-to project. Instead, I'm simply going to outline the basics and will leave it up to you to use whatever suitable parts and materials you can come up with. Feel free to improvise! You may very well discover some ideas for improvements and I'd be happy to hear any suggestions that I'll pass along.

This project does call for a certain amount of basic electronics knowledge and hands-on experience, so if you are somewhat challenged in this department I suggest you enlist the assistance of someone who knows how to use a soldering iron.

Essentially, you will be using a speaker as an infrasound microphone. Here's how it works:

A speaker basically consists of three working parts: the cone, the voice coil, and a magnet. The voice coil consists of many turns of fine wire and is physically attached to the cone. These parts are mounted to the speaker's frame with a flexible suspension system that allows the cone and coil assembly to move back and forth. The voice coil is positioned so that it lies within the field of a permanent magnet that is mounted rigidly to the frame. In normal use, the electrical signal from an audio frequency source is applied to the ends of the voice coil's wire which creates a fluctuating magnetic field surrounding the coil. This constantly changing electromagnetic field reacts to the fixed field of the permanent magnet with an ongoing attraction/repulsion effect that results in the speaker's cone being thrust back and forth in synch with the applied audio frequency signal. Movement of the

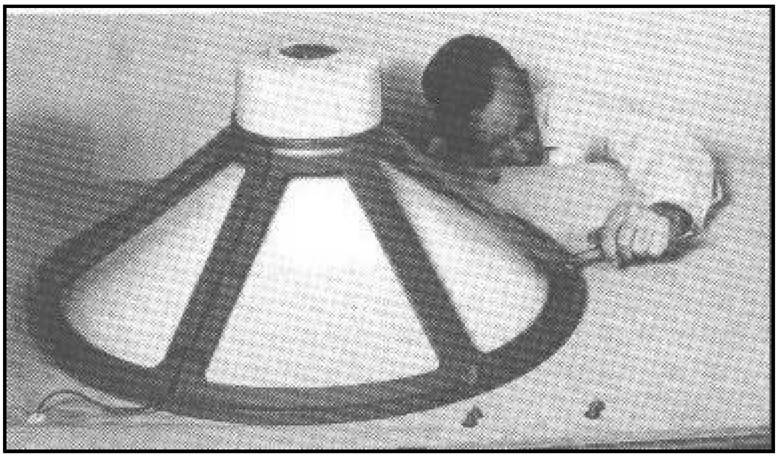
speaker's cone exerts an equivalent pulsating force to the surrounding air and, voila, sound waves are generated.

As it happens, the principle described above can be reversed:

Movement of the speaker's cone will in turn move the voice coil through the field of the permanent magnet and a small current will be generated in the coil. Thus, a speaker can be made to serve as a microphone with ambient sound waves creating resonant vibrations in the cone which moves the voice coil in relation to the magnet thereby generating a fluctuating electrical current that corresponds to the fluctuations of the incident sound waves. Good quality 'dynamic microphones' use this principle in their design and in fact, the same basic principle was used by the geophone.

So then, the first thing you need for your infrasound detector will be a suitable speaker...

Bigger speakers will respond better to the low frequencies so try to find one at least 10" in diameter, 12" or 15" should be even better. In technical terms, your speaker should have as low a resonance frequency as possible. The speaker doesn't need to have a high power rating since we won't be putting any power at all into it. It can be an oldie - in fact it doesn't even matter if the paper cone has a few small tears. These can be repaired with glue or even tape for our purposes, so you might find one that's unfit for normal use but will work great as an infrasound detector.



From How To Design, Build, & Test Complete Speaker Systems
By David B. Weems - TAB Books c. 1978

Well, it doesn't have to be this big...

But it is essential that the voice coil and suspension are in good working order. The coil can be checked with an ohm meter and you shouldn't hear any rubbing noise when the cone is pushed lightly back and forth by hand. Of course you can simply try hooking the speaker to the output terminals of your stereo - if it plays OK it should be alright to use for this project.

If the speaker is already mounted in an enclosure you're ahead of the game, otherwise you will need to install it in a housing of some kind. If you know a little about designing speaker cabinets feel free to put that knowledge to use since a good design will enhance the low frequency response characteristics. I've found that a very simple plywood box works OK - but remember, the enclosure's design must allow for sound waves to be directed at the speaker's cone.

Next you will need a small electronic component called an audio transformer...

Radio Shack sells one for about $3, it's their part # 273-1380.You may notice that the specs list this component as having a frequency range of 100-10,000 Hz. Obviously 100 Hz doesn't get us down into the infrasound range but don't worry - the transformer won't suddenly stop working at 100 Hz, it's just that its efficiency level falls below a certain standard at about that frequency.

In fact, a similar situation will apply to most of the components used in our experimental infrasound detector. Standard audio frequency components simply aren't designed for good performance at sub-audio frequencies (actually they're usually designed to reject these frequencies) but my experience has shown that they can and do work well enough.

As for the audio transformer, in electronics terminology this device provides impedance matching between the low impedance output of the voice coil and the high impedance input of an amplifier (we'll get to the amplifier in a moment). Better quality audio transformers rated for lower frequency applications can be found (especially if you're willing to pay a lot more) but again, I've found that Radio Shack's $3 part works well enough so let's go with that for now. You will need to solder the two wires from the low impedance side (the red and white wires) directly to the terminals of the speaker. If you're using a cabinet mounted speaker, you can simply attach the ends of the transformer's wires to the terminals provided on the cabinet. (This might involve soldering the transformer's wires to a suitable connector such as an RCA plug first.)

The other side of Radio Shack's 273-1380, the high impedance side, has three wires - blue, black and green. Any pair can be used, I generally work with the two outer wires, the green and blue. You can just clip the black wire off if you like. The remaining two wires will go to the input of an audio amplifier and will be connected to the leads from a length of cable suitable for that purpose. The same two transformer wires will also be soldered to the leads of a 100 mFd capacitor. The capacitor serves as a low-pass filter helping to prohibit unwanted high frequency signals from going through to the amplifier. (Note: The transformer's green wire goes to one lead of the cap, the blue wire to the other.)

In my prototype, I used a plug-in component board that allowed me to try different capacitor values and I found that 100 mFd gave the best overall results. Your system might behave differently so feel free to experiment with different values in that range. As a test, try monitoring the output of the speaker~microphone through your amp's headphone output. Ideally, you don't want to hear too much ordinary sound. The correct capacitor value should filter out all but the deepest rumbling tones, voices should be almost completely eliminated. Of course Radio Shack sells capacitors, the 100 mFd electrolytic is part # 272-1016.

The photo at right shows an audio transformer's low impedance leads clipped to the terminals of a 15" speaker. The transformer's high impedance leads go to a plug-in 'breadboard' where they make parallel connections to a 100 mFd capacitor and a short

length of 2 conductor cable. It doesn't matter which of the transformer's leads go to which terminals of the speaker or capacitor and cable as long as you keep the high and low sides paired correctly.

The assembly will actually work as shown but soldering connections and mounting in a protective enclosure will be needed for practical use. The short cable used in this test set-up should be replaced with a length of shielded cable that has whatever type of plug is appropriate for your amplifier.

Test assembly of the speaker~microphone.

Alrighty then, now you have a speaker connected to one side of an audio transformer and the other side of the transformer connected to both a capacitor and the leads from a cable. The cable needs to be long enough so that the speaker can be placed some distance away from your observation point, about 25 feet is probably a sufficient minimum. Shielded cable is preferred, especially if you plan to go much longer than 25 feet or work in an environment where interference from electrical noise is a problem. What's on the other end of the cable (a plug of some sort) depends on the amplifier you plan to use and that's the next major component in this project.

The electrical signal coming from the speaker~microphone is extremely weak and needs to be amplified to a usable level. If you have a tape recorder with jacks for an external microphone input and earphone output it might work OK for starters. I've even found that Radio Shack's pocket-size 'Mini Amplifier' (part # 277-1008) can be used as an infrasound amplifier. For best performance though, this is the one component where better quality will yield significantly better results. While you aren't going to find any consumer grade amplifiers designed to work at infrasonic frequencies, it's worth using the best amp you can get and it should be one with an input specifically intended for microphones. For my prototype, I've been using the mixer section of a four track Sony mini-disc recorder which is rated for 20 Hz and provides a nice clean output to the oscilloscope.

Oscilloscope?

Yes, this project calls for using an oscilloscope to provide a visual display of infrasound waves.

An oscilloscope is an electronics test instrument that converts electrical signals into waveform patterns that can be viewed on what's called a Cathode Ray Tube (CRT), sort of like a

miniature TV screen.

Now if you've never used (or never even heard of) an oscilloscope, don't panic. A friendly electronics hobbyist or perhaps a tech school instructor should be able to get you started and may even be willing to loan you one for your research.

The one at right was purchased on e-bay for about $45 and that included shipping. It's fairly light and compact for an older model, very easy to use.
With two separate input channels it's great for testing stereo equipment too.

An oscilloscope.

For our purposes, only the most basic functions of the oscilloscope are called for and you won't need a degree in electronics engineering to learn how to use it. Suitable scopes are plentiful on e-bay in the $50-$100 range and while even the most rudimentary of machines will serve for this project, I would advise you to steer clear of a really old one that uses vacuum tubes (unless it's free). As an alternative to buying an actual oscilloscope, software is available that lets you use a computer as an oscilloscope (or as a spectrum analyzer) so if your expertise runs in this direction that might be the way to go. Either way, the idea is that you will be able to see on the screen a visual display that identifies the presence of infrasonic frequency waves.

To finish the project, you will need one more length of cable, this one to go from the output of your amplifier to the input of the oscilloscope (or computer). This could get a little tricky since most scopes use a type of connector that you may not be familiar with - you will probably need to use a cable with either 'banana plugs' or a 'BNC' connector. If you've gotten this far you can certainly deal with this last minor detail and of course good old Radio Shack should be able to help you get plugged in. By the way, you shouldn't need to use the 'official' probes that may have come with your scope but once again, good quality shielded cable is called for.

Now, if everything's hooked up correctly and working properly...

With the oscilloscope's display set to an appropriate time base you will be able to 'see' any infrasound waves that may be present and get an indication of their relative strength. If you happen to have a signal generator that can be set to these low frequencies, you can use it to test your infrasound detector's effectiveness. Otherwise, watch for infrasound patterns from ordinary sources like traffic, wind and thunder. You will know you're detecting infrasound when you see the pattern on the scope suddenly give a strong display of infrasound waveforms although you hear nothing with your ears.

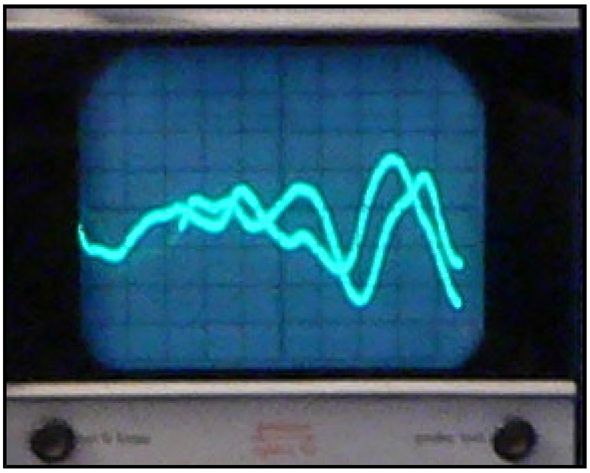
Here's my "Junkbox Infrasound Monitoring System" (JIMS) in action:

The speaker and its

associated components are mounted in the plywood box at lower right.
Note that I've installed two sets of connection terminals and a switch to disconnect the audio transformer so that I can still use this speaker for normal purposes.

In field applications, the speaker~microphone assembly should be positioned well away from the observer's location to help minimize signals from slight movements. Even so, the unit will be very sensitive to vibrations from various non-paranormal sources.

For the photo above, a 30 Hz signal from a computer based signal generator was fed into an ordinary speaker about 10 feet away from the infrasound detector. The cable leading out from atop the infrasound speaker~microphone plugs into my Sony mini-disc four track recorder which sends an amplified signal to the oscilloscope. As you can see, the scope is displaying a reasonably sine-like 30 Hz waveform which demonstrates that the experimental infrasound detector is working well.



Most of the time the oscilloscope trace will be moving and undulating like a drunken serpent. At left, the double line effect is due to my camera's exposure time being almost twice as slow as the scope's electron beam, but you can still make out the infrasonic waveform (about 15-20 Hz) that was produced by a passing truck. Note that most sources of ordinary noise don't produce a single pure frequency. In fact, that's why they call it noise.

Traffic, including airplanes, helicopters and trains, as well as many other man-made and natural phenomena can all generate infrasound. What effect do these frequencies have on our biological systems? Are there other as yet unknown sources of infrasound?

The infrasound detector described in this article can provide a good starting point

for exploring these and other questions in a field where amateur researchers can still make significant contributions to science.

Good luck with the project, let me know how it goes and what you discover!

Post Script:

As I wrap up this article I realize that many of you will be stymied by the whole oscilloscope thing but I hope you do tackle the challenge of obtaining one and learning a little about using it. If you do, you will soon find that having an oscilloscope (whether a stand-alone unit or PC based) opens all sorts of possibilities for unique electronic projects.

I also think you will find that the project described above can offer some useful results even without the oscilloscope. You can simply use the basic speaker~microphone device with an amplifier to monitor ambient low frequency sound with your ears (preferably through a pair of earphones rated for excellent bass response). By definition, you can't actually hear infrasound but you may very well encounter some other interesting audio phenomena. You can even try taping the sounds picked up by the system and listening for possible low frequency EVP's that would have gone undetected by ordinary methods of sound recording.